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FEM Analysis of Concrete Filled Single and Double Skinned Circular Thin Walled Steel Tubular Column

GoutamVarma[1], Dr. Pankaj Singh[2], Kapil Kushwah[3], Mayur Singi[4]

[1]Research Scholar, Civil Engineering, SRKU, Bhopal, MP, India
[2]Professor, Civil Engineering, SRKU, Bhopal, MP, India
[3]Professor, Civil Engineering, SRKU, Bhopal, MP, India
[4]Professor, Civil Engineering, SRKU, Bhopal, MP, India

Abstract: **Concrete filled steel tubular members comprise of a steel hollow section of circular or rectangular shape filled with plain or reinforced concrete. They are used in multi-storey buildings as columns and beam-columns, and as beams in low-rise industrial buildings where a robust and efficient structural system is required. The objective is to analyse CFST column by finite element method software (ANSYS) results obtained by using ANSYS software are analyze for evaluate the Compression effect of concrete filled steel tubular columns, observe the behaviours of the confined and unconfined concrete columns subjected to axial loading, understand the behaviour of double steel tube in confined columns, compare the compression effect with conventional single skinned solid CFST with double skinned hollow CFST, & Evaluating the stress – strain & deflection for confined and unconfined specimens.**

Keywords: **Concrete filled steel tubes, Hollow steel tube, Single skinned steel tube, Double skinned steel tube.**

I. INTRODUCTION

The benefits of both steel and concrete are used by the leaders of concrete lined steel tubular (CFST). We consist of a stee l hollow portion filled with plain or reinforced concrete in a circular or rectangular form..They are widely used as column s and beam columns in high-rise and multistory buildings and as beams in low-rise industrial buildings requiring a robust and efficient structural system.In terms of both structural efficiency and design series, there are a variety of distinct advantages associated with such structural structures. The concrete base contributes more to axial compression resistance.Since 1970, extensive research has confirmed that framing systems consisting of con crete-filled steel tube (CFT) columns have more advantages than ordinary reinforced concrete and steel systems, and as a result, this system has been used very frequently in the construction of mid- and high-rise buildings in Japan. In recent days, it is necessary to build the high-story buildings due to the growth of cities. Composite buildings for multi-story building are promising. As a result, composite columns have recently experienced increased worldwide use, driven by the development of high-strength concrete allowing such columns to be substantially saved. Columns are designed toresis the majority of axial force by concrete alone can be further economized by theuse of thin walled steel tube.

II. RELATEDWORK

In recent days, it is necessary to build the high-story buildings due to the growth of cities. In 1961, Naka, Kato, et al., wrote the first technical paper on CFT in Japan. It discussed a circular CFT compression member used in a power transmission tower. In 1985, five general contractors and a steel manufacturer won the Japan‟s Ministry of Construction proposal competition for the construction of urban apartment houses in the 21st century. Since then, these industries and the Building Research Institute (BRI) of the Ministry of Construction As a result, composite columns have recently experienced increased worldwide use, driven by the development of high-strength concrete allowing such columns to be substantially saved.

started a five-year experimental research project called New Urban Housing Project (NUHP), Research findings obtained from this project formed present design recommendations for the CFT column system.

A comparative study of concrete filled steel tube columns under axial pressure was performed by PanduRangaKirankumar.T, 2016. The analysis addresses the composite column's actions and various codal requirements. Experimental research performed through a comparative study of experimental results and empirical results for hollow steel tubes (HST) and concrete filled steel tubes (CFST) under axial power. ShankarJagadesh, 2014 conducted a study about the behaviour and the characteristics of CFST columns are the prime need of the hour. This paper presents the innovative experimental investigations conducted on CFST columns and the load deflection response characteristics of columns are also addressed. A comprehensive summary of various analytical and numerical studies on modeling of CFST members is portrayed in this paper. The design specifications and standards by AIJ, Eurocode-4, ANSI/AISC and AIK are addressed.

Lin-Hai Han, Wei Li, ReidarBjorhovde, 2013 carried out an experimental study to date on the development of the family of concrete-filled steel tubular structures and draws up a research framework for CFST members. In recent years, particularly in China, the development of research on CFST structural members is summarized and discussed. The emerging approaches to development from different countries are investigated.

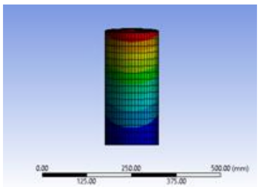
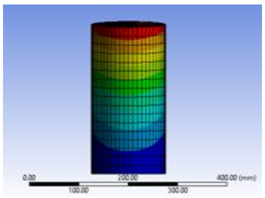
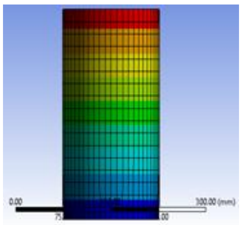
III. SCOPE

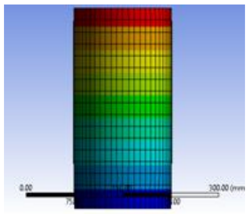
The aim of this study is to use simple methods to make useful improvements in the column power. It will also help to use Stiffened concrete filled steel tubes in different construction works in practical applications. The present research may be expanded to include cases of other forms of mounting. More complicated type of CFST specimens with various cross sections can be tried. Scope for future

IV. MODEL

In this paper, models for ANSYS code are produced and analyzed to evaluate and compare the axial strength and failure modes of these models with the others. The top and bottom surfaces of the concrete–filled circular steel tube columns are set against all degrees of freedom except for the displacement at the packed end, which is the top surface, in the direction of the l applied.

Table 1: The ANSYS models used for the paper

SL NO:	MODEL NAME	SPECIFICATIONS	ANSYS MODEL
1	D-1 (SSS-CSFT)	T_1 = 3.5mm, t_2=0, D_1 = 150 mm, D_2 = 0 mm, L = 300 mm	
2	A-1 (DSH-CSFT)	T_1 = 3.5mm, t_2=2.5, D_1 = 150 mm, D_2 = 75 mm, L = 300 mm	
3	B-1 (DSH-CSFT)	T_1 = 3.5mm, t_2=2.5, D_1 = 150 mm, D_2 = 85 mm, L = 300 mm	

4	C-1 (DSH-CSFT)	T_1 = 3.5mm, t_2=2.5, D_1 = 150 mm, D_2 = 95 mm, L = 300 mm	

V. RESULTS

The CFST specimens were analysed using finite element analysis in ANSYS workbench. The results of the finite element analysis are included in this chapter. After analysing the specimens, the deformations at each and every load were obtained from ANSYS. Non-linear analysis was carried out for all the specimens.

The ultimate load carrying capacity of the various specimens from the analysis is indicated in Table.

Table 2: for Ultimate load on columns and stress

S.No	Circular Size	Max Load (KN)	Max Deflection (mm)	Equivalent (Von-Mises) Stress (Mpa)	Equivalent Elastic Strain(mm/mm)
1	150*3.5 D-1 (SSS-CSFT)	1770	0.08361	767.23	0.0042386
2	150*3.5*75*2.5 A-1 (DSH-CSFT)	1800	0.40941	2456.4	0.012282
3	150*3.5*85*2.5 B-1 (DSH-CSFT)	1810	0.412	2865	0.014325
4	150*3.5*95*2.5 C-1 (DSH-CSFT)	1830	0.4175	2497.9	0.01249

VI. CONCLUSION

The finite element analysis of stiffened concrete filled single and double skinned thin walled steel tubular column specimens were carried out for studying the ultimate load carrying capacity and behaviour. For different specimen models were analysed for this. A conventional column with circular cross section was first modeled and analysed for validation. Then a circular column are modelled by providing outer skin only without providing conventional reinforcement and analysed. Then in addition to the outer skin, the specimen were analysed by providing an inner steel skin. Then the test is repeated by the column throughout the length and analysed for all thecases.

When the double skinned circular column is compared with conventional circular one and single skinnd solid concrete filled steel tube, the compressive strength is increased by40 times in SSSCFST and It is increased by almost four times than single skinned CFST in double skinned CFST., it also increases the load carrying capacity well as compared to conventional specimens.

The present study can be extended to include cases of other types of loading.More complicated type of CFST specimens with various cross sections can be tried. Study based on varying the shape of Stiffeners in the CFST.Study based on altering the confinement. The work can be extended to study the behaviourof cyclically loaded CFSTbeams

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